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ABSTRACT

A multivariate correlational study examined interrelationships among personal and contextual variables and early childhood administrators' willingness to implement computer technology. A total of 80 administrators of programs in the state of Illinois with a licensed capacity of 80 or more participated in the study. Dependent variables included level of administrator innovativeness with respect to managerial and classroom instructional uses of the computer. In addition to gender and age, independent variables included self-efficacy expectations, attitudes about computer technology, self-perception of innovativeness, experience with and knowledge about computers, previous experience with educational innovations, outside support and encouragement, professional orientation, and background in math and science. Data were gathered through questionnaires, follow-up telephone conversations and personal interviews. The data support a general stage theory conceptualization of innovativeness. For this sample, the stage sequence was further differentiated by a series of steps that characterized the degree of willingness individuals displayed regarding the adoption of microcomputers. Individuals varying in innovativeness with respect to microcomputers differed significantly in their self-efficacy and psychological attitudes about computers, as well as in their previous experience with and knowledge about the technology. Significant statistical associations were found between most independent variables and level of innovativeness in instructional and administrative uses of computers. Implications of the findings for teacher education are discussed. (RH)

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MICROCOMPUTERS IN EARLY CHILDHOOD EDUCATION:

FACTORS INFLUENCING ADMINISTRATORS' INNOVATION-ADOPTION DECISIONS

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INTRODUCTION

The restructuring of America from an industrial to an information society is having a profound impact on the way we think, the way we relate to one another, and the way we process information. Sweeping innovations in communications and technology are also transforming our educational system at all levels (OTA, 1982). Indeed, many believe that the most formidable challenge of the decade will be to train people to work in this emerging information society (Molnar, 1978; MECC, 1980; McIsaac, 1979). To make that transition, perhaps no skill will be as vital to educational administrators as the ability to manage change (Estes & Watkins, 1983). It is the administrator as leader who is the catalyst that senses the need for change, sets the pace for the change process, and then monitors its progress as each new idea is translated into a program of action (McGeown, 1979; Chesler, Schmuck & Lippitt, 1975; Crandall & Associates, 1982).

If the ability to adapt to change is such an essential part of effective leadership, then an awareness of the factors that help explain and predict innovation-acceptance can make an important contribution to our understanding of coping in a changing society (Gardner, 1981). But the issues surrounding the adoption of an innovation are complex. In deciding on an appropriate course of action with respect to any organizational change, the administrator is often caught in a double bind with two conflicting responsibilities: maintenance of the system to ensure continuity, and the necessity to change the system so it performs more efficiently (Havelock, 1973).

Unfortunately, there are few theoretically-based, empirically-tested tools to assist administrators in the implementation of change. Much of the literature portrays change as a novel event interspersed between periods of organizational stability (McGeown, 1979). But administrators do not have the luxury of viewing change as a novel event. The pressures inherent in their positions mean that they must make many decisions daily that affect the future of their programs.

During the next few years, early childhood administrators will be faced with important decisions regarding the implementation of computer technology. Until recently it has been considered economically untenable for most programs to implement computers for managerial or instructional purposes. However, the low cost and impressive capabilities of some microcomputers currently available now make them an attractive and financially feasible innovation to consider for any early childhood program with a client base of 50 families or more (Neugebauer, 1983).

The computer's impressive power to organize, analyze, and process information has already taken it out of the realm of the esoteric and made it an organizational necessity for some early childhood directors. As a managerial tool, they have found the computer to be an indispensable aid for stretching limited resources and cushioning the effect of rising educational expenditures (Melmed, 1983; Hoover & Gould, 1982). As an educational tool, the computer is challenging established traditions of what constitutes "teaching" in the classroom. The computer provides a new kind of interactive medium that helps teachers manage instruction in more individualized ways, thus facilitating students' learning of important concepts (Taylor, 1980).

Many administrators' understanding of computers has not kept pace with technological advances, however. Some feel that computers are infallible and blame themselves for their failure to grasp the intricacies of the technology. As a consequence, they harbor reservations about their ability to implement the innovation. The purpose of this study was to explore the relationship between selected personal attributes of early childhood administrators and their decisions regarding the utilization of microcomputers. The results of this study should prove useful to early childhood practitioners who must evaluate the merits of the technology as either a managerial or instructional tool. In addition, this research should also be useful to those in teacher training institutions seeking to develop programs that assist early childhood teachers and administrators to cope with organizational change in healthy and constructive ways.

CONCEPTUAL FRAMEWORK

The literature dealing with innovation as it relates broadly to adopter characteristics, and more specifically to the application of computer technology, cuts across several fields and disciplines including psychology, education, communications, and organizational management. Studies vary widely in scope and conceptual clarity as well as in the assumptions they make about organizations and human behavior. The differences between theories are often subtle and at times merely semantic. This summary of the literature review surveys pertinent research relating to the adoption of educational innovations. It first presents an overview of the innovation decision process, detailing the stages involved in assessing degree of individual innovativeness. It then looks at some situational, demographic, and personality factors that appear to influence innovation adoption.

The Innovation Decision Process

The work of Miles (1964) provides a convenient starting point for understanding the innovation decision process. Miles states that an innovation is any deliberate or specific change which is thought to be more efficacious than current practice in accomplishing the goals of the school. He stresses that innovations are changes that are planned and anticipated rather than those that occur haphazardly. Fliegel and Kivlin (1966) add that an innovation must be perceived as having a high reward value and as involving some risk and uncertainty. They also stress that the proposed idea must represent something new or novel to the people being changed. Thus, the innovation need not be "new" by some objective standard. It is the perceived newness of the selected practice by the potential adopter that counts.

In general, the innovation decision process has been conceptualized as a sequence of stages which characterize how individuals or organizations come to know about a particular innovation and ultimately decide to accept or reject it. Researchers such as Rogers (1983), Hall and Loucks (1975),

Havelock (1973), and Ettlie (1980) have all described the innovation decision process in slightly different ways, but the sequential stages in their models seem to reflect a similar pattern. Figure 1 is a synthesis of these stage-model conceptualizations depicting five steps in the process. These steps include: 1) awareness that an innovative practice exists but complete information is not yet available, 2) expressed interest in a new idea so that additional information is actively being sought, 3) assessment of the innovation to determine its usefulness and applicability in light of present circumstances; 4) tentative adoption of the innovation on a limited basis, and 5) full-scale adoption and institutionalization of the innovative practice into the ongoing life of the organization.

It would be inappropriate to regard these postulated stages as being mutually exclusive or temporally equal. Rather, it may be more useful to regard them as interacting elements occurring in a series of cyclical feedback loops. Detailing the stages in the innovation decision process also provides more than heuristic value for understanding the sequence of events in implementing an innovation. Not all individuals in a social system adopt innovations at the same rate. Therefore, the stage model also has value for assessing the degree of innovativeness exhibited by an individual or an organization. Rogers (1983) explains that "innovativeness" is a relative dimension. It is the degree to which an individual is relatively earlier in adopting a new idea when compared to others in the social system.

Since rejection may well be the outcome of the process, it is important to stress this is a decision-making process rather than merely an adoption process. This alternative terminology helps temper the subtle but pervasive influence of the "pro-innovation bias." This is important because in this age of futuristic thinking, it is tempting to view opposition to innovation as if it were a question of morality. Those who stanchly defend the status quo are often labeled "resisters" or "laggards" while those who are quick to pick up the guantlet are considered "pioneers." Giacquinta (1975) emphasizes that these are emotionally charged terms that convey an obvious partiality.

The pro-innovation bias is particularly strong when one looks at computer technology. Weinberg (1966) refers to a similar phenomenon, the "technological fix," as an overdependence on technology to solve our complex social problems. The pressure to get on the technological bandwagon is subtle and pervasive even for administrators who have limited information about specific applications of the innovation. It is not difficult to see why. As Brod (1984) notes, computers have been hailed as the most significant advance in the history of civilization, an indispensable adjunct to daily life. He states that the selection of the computer as the "Machine of the Year" by Time magazine dramatizes it as the central hero and metaphor of our time. Consequently, many individuals fear obsolescence if they do not embrace the technology. They fear they will become relics of a backward culture and viewed as old-fashioned. Rogers (1983) believes the tendency to accept new technology uncritically is a serious shortcoming of innovation diffusion research. He stresses that the adoption of certain innovations may not be uniformly useful for all individuals or all organizations.

Factors Influencing Innovation Adoption

There are many interrelating factors that can potentially influence one's behavior with respect to decisions about the adoption of an educational innovation. This section will focus on five such factors that appear to have some significant explanatory power. These include: attributes of the innovation, self-perception of innovativeness, self-efficacy expectations, age and gender, and professional orientation.

Attributes of the Innovation

Embodied in the innovation decision process is the assumption that the individual responsible for the adoption/rejection decision weighs alternatives to discern the relative advantages of a particular innovation over existing practices or other potential innovations. These alternatives generally center on various attributes of the innovation and thus serve as

incentives for adoption. The individual's perceptions of these attributes are of considerable importance because they help explain why some innovations enjoy rapid and widespread dissemination, others fade to obscurity, and still others evoke such strong resistance.

Drawing predominantly on the work of Zaltman and Lin (1971), Rogers (1983), and Fliegel and Kivlin (1966), it is possible to develop a taxonomy of some of the characteristics used to classify microcomputers as a type of innovation. Taken together these attributes represent a fairly comprehensive set of criteria for making adoption decisions. They include: 1) the cost-effectiveness of the innovation relative to other variables such as increased output or reduced operating costs, 2) the status and social approval conferred by the new practice, 3) the complexity of the innovation and the specialized skills required to implement it, 4) the efficiency resulting from use in terms of time saved or the avoidance of discomfort, 5) the degree to which an innovation can be experimented with on a trial basis before full-scale adoption, 6) the degree to which the results of implementation are observable to others, 7) the extent to which the innovation can be easily communicated or demonstrated to others, 8) the compatibility of the new practice with the individual's present values and past experiences, and 9) the ease with which the innovation may be terminated.

It is important to underscore the salience of individual differences in people's perceptions with respect to these innovation attributes. What may appear to be a simple and easily understood innovation to one person may seem like a highly complex and intimidating one to another. Even so, microcomputers present an enigma if one looks a their broad appeal. They simply do not fit the standard paradigm of what constitutes a readily accepted and easily implemented type of innovation. They are complex, require specialized skills, are difficult to communicate to novices, and not easily reversed without considerable cost. Yet at the elementary and secondary level they have achieved an unparalleled adoption rate in some school districts.

Self-Perception of Innovativeness

Self-reports have been shown to be consistently good predictors of many types of behavior (Shrauger & Osberg, 1981). In supporting the use of self-report measurements, Hurt, Joseph, & Cook (1977) contend that how individuals view themselves with respect to the personality dimension of innovativeness provides an accurate predictor of innovation-acceptance behavior. Many of the research studies in this tradition have conceptualized innovativeness as a stable and enduring personality trait. A number of studies suggest that innovativeness has a positive association with certain personality characteristics such as creativity, openness, flexibility, venturesomeness, risk-propensity, and internal locus of control (Gardner, 1981; Rogers, 1983; Robertson, 1971; Carlson, 1965; Coovert & Goldstein, 1980).

The work of Kirton (1976, 1980) stands out as particularly noteworthy. Kirton was intrigued by the notion that people characteristically produce qualitatively different solutions to seemingly similar problems. He conceptualizes the trait of innovativeness as a behavior preference related to two contrasting cognitive styles. Kirton contends that the behavior of every person can be located on a continuum ranging from a preference to "do things better" to a preference to "do things differently." The ends of this continuum are labeled adaptive and innovative, respectively. The adaptor is characterized by precision, efficiency, and conformity, and is concerned with resolving problems rather than finding them. The innovator, in contrast, questions assumptions and existing problem-solving paradigms and prefers to approach tasks in unusual, different, and sometimes unorthodox ways.

When one moves from theoretical constructs to practical application, Kirton's conceptualization of innovativeness is particularly appealing because it may assist in promoting collaboration in an organization setting. By treating the noninnovative person in nonpejorative terms, the approach emphasizes that a balanced staff is needed in order to be prepared for all contingencies. Kirton (1976) states that by stressing improved knowledge of

each others preferences, an organization may well "allow for mutual appreciation and consequent cooperation between those with different, potentially equally valuable, modes of problem perception and problem solving" (p. 622).

Self-Efficacy Expectations

A conceptualization of innovation acceptance as a generalized trait may be insufficient for understanding why people respond differently to different innovations, why their responses change over time to the same innovation, and why advocates of change in one setting often become resisters of change in another. Bandura's (1982) theory of self-efficacy provides a helpful framework for understanding an individual's feelings of competence in dealing with change in this situation-specific context. Self-efficacy is concerned with judgments about how well one can organize and execute courses of action required to deal with prospective situations that contain ambiguous, unpredictable, and stressful elements (Bandura, 1982). These judgments are important because self-percepts affect not only the course of action that people pursue, but also their thought patterns and the emotional arousal they experience. This approach may also help elucidate why some individuals may feel quite efficacious with respect to implementing certain innovations but cautious and reticent with respect to the adoption of computer technology.

Self-efficacy theory posits that people form estimates of their personal efficacy by evaluating information from several important sources:

Past Direct and Indirect Experiences. Past experiences play a powerful role in shaping present behavior. Experience and self-knowledge go hand and hand, so direct experiences enable individuals to make more informed choices and more accurately assess their ability. Thus, individuals who have had more direct experiences with microcomputers or related technology have a greater experiential base from which to form efficacy expectations. Likewise, indirect experiences such as observing others interact with computers can

also serve as important sources of efficacy information. Vicarious experiences allow individuals to form a concept of how to perform new behaviors. At a later time that symbolic construction can serve as a guide for action.

Verbal Persuasion. Although self-efficacy expectations formed from verbal persuasion are likely to be weaker than those resulting from one's own experiences, persuasion can be an important source of efficacy information. When verbal persuasion is viewed as support and encouragement as opposed to direct or subtle pressure, it can have increased informative value. This may be particularly true in the case of microcomputers where the risks associated with adoption are often perceived as high, the innovation itself perceived as complex, and actual opportunities for first-hand experiences may be limited.

Emotional Arousal. Any attempt to understand the nature of resistance to computer technology cannot ignore the power of emotions in regulating behavior. Physiological responses associated with arousal provide valuable information about personal competency. High arousal generally debilitates or inhibits performance (Bandura, 1982). Emotionally-laden attitudes, those gut feelings about new experiences, can also be strong motivators in situations calling for innovation acceptance. Psychological attitudes about computers are particularly important to assess because of the dichotomous emotional reactions the technology elicits -- one pole indicates mistrust and fear, the other indicates an appreciation and respect for the technology (Lee, 1970).

Age and Gender

Research conducted on the relationship between age and degree of innovativeness is mixed. Some studies report more favorable attitudes and receptivity to change in younger subjects while other studies report contrary trends (Rogers, 1983; Christensen et al., 1983). Nevertheless, the issue is worth investigating. It is possible, for example, that age as it relates to years of experience on the job may be an important variable in a person's openness to change. Chesler and Barakat (1967) explored this issue and found

a curvilinear relationship between years of experience and innovativeness. Teachers with a moderate amount of experience were most innovative.

The data on gender differences are more clear. Rogers (1983) provides evidence showing that females are typically more risk-averse and show lower levels of innovative behavior than males. Males also report higher levels of self-efficacy in a number of studies summarized by Maccoby and Jacklin (1974). Although the findings vary across tasks and age levels, the evidence generally shows that females view themselves as less efficacious than boys at intellectual activities stereotypically associated with males.

Hackett and Betz (1981) also share these views about gender differences. They postulate that women lack strong expectations of personal efficacy with respect to many career-related behaviors and thus fail to fully develop their capabilities and achieve their potential in career pursuits. Kreinberg and Stage (1983) report that these lower expectations are particularly likely to be held with respect to computer technology. Women's lower level of confidence with computers inhibits them from gaining the experience necessary to break down stereotypic patterns of behavior and adverse emotional reactions to the technology. From a socialization perspective the effect is doubly injurious because it deprives young girls from having role models that might help diminish negative stereotypes (Lowe, 1983).

Because computer competence is related to math and science (Fox, 1978; Rothchild, 1983; Miura 1983), it stands to reason that individuals who have had extended opportunities in an educational setting with math and science coursework would feel more comfortable with a technological innovation like microcomputers. Tobias (1978) has documented the incidence of math avoidance in various groups, noting that math anxiety is a condition that disproportionately affects females and racial minorities. It grows out of a culture that associates math and science ability with masculinity and discourages girls from enrolling in courses in these areas (Skolnick, 1983).

Professional Orientation

The extent to which educational organizations are receptive to innovative ideas depends in large part upon the professional orientation of those involved in the implementation of the change (Corwin, 1975). Professional orientation can be construed as a role perception variable influenced both by administrators' sociodemographic characteristics such as level of educational achievement, income, and social status (Giacquinta, 1975; Rogers, 1983) as well as certain contextual factors such as size and structure of the organization (Baldridge, 1975). Corwin (1975) believes there is often a threshold point in the scale of an organization that seems to provide more support for change. Rogers (1983) notes that size is probably the best single indicator of the financial and human resources available to commit to implementing new ideas. Larger organizations also tend to be characterized by more conflict and uncertainty which can add to the press for change.

Professionalism is promoted by networks that extend outside the social system. Carlson (1965) found, for example, that when administrators are "cosmopolitan" in their activities, innovative behavior is more likely to occur than when they have a "local" approach to their role responsibilities. The most common sources of innovative ideas for educators are professional publications, professional meetings and conferences, contacts with publishers, graduate courses, and visits to other schools.

OVERVIEW OF THE STUDY

This study is a hybrid of innovation research traditions looking at change through the lens of self-efficacy theory. Within the context of an educational setting, the study views innovativeness as a hierarchical construct in which some of the variance can be explained in terms of a general personality attribute and the remainder in terms of situation-specific variables referring to either internal or external change processes.

These situation-specific variables can relate to the organizational context of change or to the particular innovation being considered--in this case, microcomputers.

The primary goal of this study was to isolate the characteristics that distinguish those administrators who exhibit high levels of innovativeness with respect to administrative and instructional uses of the computer from those who do not. In doing so this study assesses the predictive power of selected demographic and personality measures as they relate to managerial and instructional innovativeness. These predictors are also contrasted with those derived from information about "external" forces that influence innovativeness, such as degree of support and encouragement from spouse, friends, or colleagues, and the overall organizational context. Beyond these more formal goals, it was anticipated that the data would also shed light on some ancillary issues. Of particular interest was the extent to which computer technology is actually being used in early childhood programs and the kinds of problems that are encountered in implementation.

Propositions Tested

Four propositions were tested in this study. They were: 1. Individuals exhibiting varying levels of innovativeness with respect to microcomputers will differ in their self-efficacy and psychological attitudes about computers as well as in their knowledge about and previous experiences with the technology. 2. Overall level of innovativeness will be greater for administrators who have a stronger professional orientation and who have had more positive experiences implementing other educational innovations in the past. 3. Self-perception of general innovativeness will be a good predictor of actual level of innovative behavior with respect to the adoption of microcomputers. 4. Self-efficacy expectations regarding microcomputer use will be greater for individuals who a) have had more educational preparation in math and science, b) are of the male gender, and c) have more support and encouragement from professional colleagues, friends, or boards of directors.

Definition of Terms

Early Childhood Education. In general, early childhood education includes programs whose primary purpose is to serve children from infancy through kindergarten. However, some programs do offer first grade as well as after-school care for school-aged youngsters. In this study the terms school or center are used to describe all early childhood organizations, including half-day and full-day programs, nursery schools, preschools, day care centers, parent cooperatives, and church-affiliated programs.

Administrator/Director. When referring specifically to those individuals whose primary responsibility is administrating the policies of an early childhood organization, the terms administrator and director are used interchangeably. Administrators represent both profit or nonprofit organizations, and spend more than half their time in a managerial, nonteaching capacity. They also hold at least some responsibility for making financial and policy decisions affecting the implementation of new innovations.

METHODOLOGY

This research was a multivariate correlational study examining the interrelationships among selected personal and contextual variables and early childhood administrators' willingness to implement computer technology.

Subjects

Eighty administrators were selected representing nonprofit and private proprietary early childhood programs in the state of Illinois with a licensed capacity of 80 students or more. The sample included 71 females and 9 males varying in administrative experience from 1 to 32 years. The mean program size was 175 children with an administrative, teaching, and support staff of 21 adults.

Instrumentation

A twelve-page questionnaire with varied response formats was used to assess both the dependent and independent variables. Most items in the survey asked subjects to check the "most appropriate answer" from several available, or to indicate "all those that apply" with respect to the particular question being studied. A few items called for short explanatory answers. In addition, there were some open-ended questions inviting general reactions and comments about the feasibility of adopting microcomputers in early childhood programs.

It can be problematic to rely on individuals' self-reports since their reports may not be congruent with their actual behavior. Respondents could, for example, adopt a response set while answering questions due to the perceived social desirability of certain items. Furthermore, surveys conducted at one point in time may not accurately reflect the attitudes and behavior of individuals as well as those measures that elicit responses over a period of time. For these reasons follow-up telephone conversations and personal interviews were conducted with many the administrators. These interviews served to clarify ambiguities in questionnaire responses and to elicit personal anecdotes about the administrator's experiences with computers.

The dependent variables observed in this study were twofold: level of administrator innovativeness with respect to managerial uses of the computer and level of innovativeness exhibited with respect to classroom instructional uses. Rogers' (1983) theory on the diffusion of innovations served as a useful framework for assessing degree of innovativeness. This theory looks at the process of innovation adoption and links the individual's stage of implementation to an adoption time frame. Innovativeness is conceptualized as a behavioral outcome; thus, it can be loosely interpreted as a direct measure of the degree to which an individual engages in innovative activities. It is determined by the index of where the administrator stands in the adoption process with respect to a five-stage adoption sequence.

In addition to assessing the background demographic variables of gender and age, eight other independent variables were also studied. These included:

Self-Efficacy Expectations. The measure assessing self-efficacy expectations adheres to the prescribed format developed by Bandura in previous research on the topic (e.g., Bandura, 1981). The questions in this study refer specifically to tasks involved in the implementation of computers and vary in degree of difficulty. Subjects were asked to judge their ability to accomplish each task (level of self-efficacy) and then indicate their confidence level with respect to that judgment (strength of self-efficacy). Since self-efficacy level and strength were fairly highly correlated (r = .54, $p < .001$), a composite score was used for the data analyses.

Attitudes about Computer Technology. Questions pertaining to attitudes about computer technology draw on the work of Raub (1981), who developed and factor analyzed a questionnaire assessing college student's computer anxiety. Raub's questionnaire was revised somewhat for the present study to be more applicable to the specific issues addressed. A total of 21 questions were used with a third falling into three factor categories: appreciation of computer technology, anxiety about using computers, and beliefs about the computer's negative impact on society.

Self-Perception of Innovativeness. The Kirton Adaption/Innovation Inventory (KAI) was used to measure administrators' self-perception of innovativeness. The KAI was selected because of its high reliability (KR-20 = .88) and the wide range of samples to which it has been applied. Cross-validation studies of the KAI have also been conducted extending its validity to other than self-perceived criteria (Keller & Holland, 1978).

Experience with and Knowledge about Computers. Questions pertaining to this variable assess administrators' understanding and knowledge of the computer as well as their direct and indirect experiences with the technology.

Previous Experience with Educational Innovations. This variable measures the degree of success individuals have had with previous educational innovations and their overall positive or negative evaluation of those experiences. This variable was included to help assess the degree to which computer-related innovativeness is a situation-specific or a general construct.

Outside Support and Encouragement. This variable refers to the type and amount of support that administrators have received with respect to the adoption of microcomputers. Support is viewed broadly and can come from a spouse, friends, students, professional colleagues, or outside contacts.

Professional Orientation. This measure is comprised of four subscales, each measuring a different aspect of the administrator's role. The subscale for organizational characteristics measures the size and degree of complexity of the organization in which the administrator works. Such factors as total enrollment, operating budget, and size of teaching staff are considered here. The education subscale measures the highest degree obtained and whether or not the administrator is pursuing advanced studies. The role and responsibilities subscale assesses the type and range of on-the-job activities in which the director engages. The final subscale assesses the kind of outside professional activities of the administrator participates in.

Background in Math and Science. Subjects were asked to note how many high school and college courses they have taken in math, science, and engineering. This variable reflects the total number of courses indicated.

Data Collection Procedures

One-hundred-twelve administrators of early childhood programs were initially contacted by telephone. The nature of the research was explained to them and they were invited to participate in the study. A questionnaire was then mailed to them along with a cover letter thanking them for their participation. A postcard and a telephone call served as follow-up reminders

to return the survey. A total of 82 questionnaires were returned. Two could not be used because the licensed capacity of the centers did not meet the minimum criteria set forth in the study. The response rate (73%) was very encouraging given that the questionnaire was quite lengthy. Follow-up telephone calls were made to approximately one-half of the nonrespondents to discern why they did not return the questionnaire. Nonrespondents can represent a threat to external validity of the data if those responses are significantly different from the population as a whole. That did not appear to be the case in this study. Both the overall rate of return and the distribution of subjects with respect to the stages in the innovation decision process made this sample quite acceptable for analysis and interpretation.

Data Analysis

Univariate correlational analyses were undertaken to assess relationships between the dependent and independent variables. In order to determine the combined effects of these predictor variables, stepwise multiple regression procedures were employed. In addition, a scalogram analysis (Guttman scaling) was used to analyze the characteristics of the items included in the index of innovativeness. Finally, discriminant analysis was utilized to determine the characteristics that distinguish those administrators who exhibited a willingness to adopt microcomputers from those who resisted.

RESULTS

The data support a general stage theory conceptualization of innovativeness. The innovative decision process in this study was characterized by five stages: awareness, active information seeking, assessment, tentative adoption, and institutionalization. The results of the Guttman scale analysis indicate that for this sample the index of innovativeness was both unidimensional and cumulative in nature. The coefficient of reproducibility for both administrative and instructional uses of the computer exceeded .95

and the coefficient of scalability for both types of uses was .75. Since the data were cross-sectional, however, one should not interpret the results of the scalogram analysis as decisive evidence for a stage theory explanation of innovativeness. This analysis does not attempt to explain why people move through these postulated stages as they do.

For this sample, the stage sequence was further differentiated by a series of steps that characterized the degree of willingness individuals displayed regarding the adoption of microcomputers (figure 2). These steps differed by the amount of knowledge and information administrators had about computers. It was found, for example, that rejection decisions were being made at several points in the innovation decision continuum but with varying degrees of information to support those decisions. This step conceptualization demonstrates that innovativeness is a far more complex trait than merely being early or late in the adoption of a new practice. Table 1 shows the distribution of subjects with respect to level of innovativeness.

Of the 80 administrators surveyed, 25 used a microcomputer either for administrative or instructional purposes. Degree of expertise varied widely as did the specific managerial and instructional applications. Administratively, computers were being used for both word processing and data management. The use of the computer as an instructional tool was not nearly as widespread because there is still a dearth of software to choose from that is both age-appropriate and educationally sound. The primary goal of those programs currently utilizing microcomputers in the classroom was one of promoting general computer awareness as opposed to reinforcing specific cognitive concepts. The general consensus of the administrators interviewed was that the computer had enormous potential as a very engaging and highly motivating interactive medium, but that care must be taken to ensure that it be used to support and enrich the entire curriculum.

Virtually all of the administrators interviewed expressed some frustration in their attempts to implement microcomputers at their centers. Their

negative experiences were most often related to the bewildering array of software available, the poor documentation accompanying software, and the unanticipated amount of time needed to become adept in using the technology.

Table 2 presents the means and standard deviations as well as the actual and possible range of scores for all of the continuous independent variables in this study. Internal consistency coefficients (Cronbach's Alpha) are also noted where applicable. Table 3 details the results of the correlational analysis. It should be stressed that the data reported in this study describe correlational relationships between certain variables and are not necessarily indicative of causal relationships. The results of the analyses do provide strong confirmatory support for several of the propositions tested. Individuals exhibiting varying levels of innovativeness with respect to microcomputers differed significantly in their self-efficacy and psychological attitudes about computers as well as in their previous experience with and knowledge about the technology. Indeed, nine of the ten independent variables correlated with level of innovativeness for administrative uses at a significance level of $p < .05$. Only age did not show a strong association. The relationships between the predictor variables and level of innovativeness for instructional uses followed a similar pattern. Here seven of the ten independent variables showed a statistically significant association with the criterion variable at $p < .05$. Only age, background in math and science, and previous experience with educational innovations did not demonstrate a statistically significant relationship with instructional innovativeness.

Regression analysis was particularly important in this study since it was assumed there would be some collinearity among the independent variables. Table 4 shows the results of the stepwise regression procedure using the ten independent variables on level of innovativeness for administrative uses. Here four variables (experience/knowledge, professional orientation, self efficacy expectations, and background in math and science) accounted for 72 percent of the variance at an overall significance level of $p < .001$ ($F = 51.73$). Table 5 details the results of the stepwise regression analysis of

the ten independent variables on level of innovativeness with respect to instructional uses. This resulted in an adjusted R-square of .51 with an overall F of 21.51 ($p < .001$) for four predictor variables (self-efficacy expectations, professional orientation, gender, and experience/ knowledge).

Discriminant analysis also provided strong support for the proposition that administrators exhibiting varying levels of innovativeness would differ in significant ways. When administrators were divided into two groups of approximately 50 percent each on the basis of their innovativeness scores, the results indicated 89 percent of the cases grouped by administrative uses of the computer could be correctly classified. For instructional uses, 75 percent of the cases were correctly classified.

Secondary analyses of the independent variable measuring psychological attitudes about computers showed that it also provided statistically significant power in predicting the criterion variable for level of innovativeness for administrative uses. Alone it accounted for 42 percent ($F = 59.41$, $p < .0001$) of the variance in the dependent variable. When combined with three other potent predictor variables (experience/knowledge, professional orientation, and background in math and science) the regression equation yielded an R-square of .71 with an overall F of 49.48 ($p < .001$). It appears that much of the predictive power of this variable is apparently shared by some of the other independent variables (in particular, self-efficacy expectations). Consequently, when all variables are entered in the stepwise procedure, the attitudes variable does not surface as a major contributing factor.

Level of innovativeness was found to have a highly significant statistical association with overall professional orientation ($r = .60$, $p < .001$ for administrative uses and $r = .55$, $p < .001$ for instructional uses). Moreover, this variable was shown to be a significant predictor of level of innovativeness for administrative uses entering in at step 2 in the stepwise regression equation. Previous experience with educational innovations, on the other hand, did not demonstrate this kind of predictive power. The correlation

between previous experience in educational innovations and administrative uses of the computer was significant (.19 ($p < .05$), but the correlation with instructional uses (.14) did not reach significance. Furthermore, this variable failed to be a strong predictor for either of the criterion variables in the stepwise regression analyses. These results suggest that computer-related innovativeness may well be a situation-specific construct.

Results of the data analyses provided solid support for the hypothesis that self-perception of innovativeness is a good predictor of actual level of innovative behavior for both administrative and instructional uses of the computer. The correlation coefficients for this independent variable were highly significant for both administrative ($r = .45$, $p < .001$) and instructional uses of the computer ($r = .46$, $p < .001$). Further analyses using stepwise multiple regression procedures demonstrated that when entered in at step 1, self-perception of innovativeness accounted for approximately one-fifth of the variance in the criterion variables.

The final proposition examined in this study yielded mixed results. It was hypothesized that self-efficacy expectations would be greater for individuals who were male, had more educational preparation in math and science, and had more outside support and encouragement from professional colleagues and friends. Self-efficacy expectations were significantly correlated with both gender ($r = .31$, $p < .01$) and support and encouragement ($r = .41$, $p < .001$), but educational preparation in math and science failed to demonstrate this level of association. Here the correlation was only .09.

IMPLICATIONS FOR TEACHER EDUCATION

Addressing some of the issues involved in the adoption of an innovation links theory to practice in a very useful and pragmatic way. It may be possible, for example, to systematically provide preservice and inservice professional guidance that will give early childhood teachers and program

directors a greater awareness of the innovation decision process. Understanding the factors that facilitate or impede acceptance of new innovations may help them to better cope with the demands of organizational change.

Results of this study suggest that the issues surrounding the implementation of computer technology are indeed complex. Psychological attitudes about computers, for example, cannot not be measured on a simple continuum of pro to con, good to bad, or positive to negative. Such a unidimensional perspective can lead to a misinterpretation of behavior. Some of the administrators in this study, for instance, have shown that it is possible to have a high respect and appreciation for the capabilities and potential of the computer and still feel a strong anxiety about personally interacting with the technology. Preservice and inservice programs can provide an important forum to help early childhood educators understand the nature and consequences of computer anxiety.

Reddin (1970) stresses that when people understand why they resist change, their resistance usually decreases or at least becomes more rational. The results of this study suggest that resistance is often a symptom of something else; fear of the unknown, fear of failure, or an unwillingness to alter the status quo. Moreover, the real reasons for rejecting technology may not be acknowledged or even be within a person's awareness. Uncovering these reasons and discussing them may help individuals better understand their reactions to new innovations. The experiences of the early childhood administrators in this study also help clarify why attitudes, self-efficacy expectations, and experience and knowledge serve as good predictors for willingness to try new practices. Several directors echoed Giacquinta's (1975) observation that the introduction of an innovation means the introduction of uncertainty into a once stable situation. Individuals are often reluctant to risk trading established imperfect order for possible disorder. Thus the logical reaction to potential change takes on a conservative thrust. But experience and knowledge help temper potential negative attitudes and fear of the unknown. Direct and vicarious encounters with microcomputers,

for example, contributed to increased feelings of control and confidence and stimulated interest in learning more about the innovation. These experiences suggest a continuing cycle where fear of the unknown is gradually diminished as positive experiences increase feelings of self-efficacy and willingness to risk greater uncertainty. The role that teacher education programs can play in providing this kind of support and self-awareness is a crucial one.

Early childhood teachers and administrators need a forum to discuss the issues involved in organizational change. They need preservice and inservice programs that guide and support them to systematically evaluate the economic, social, and psychological costs of implementing new practices. Such programs can also help temper the pro-innovation bias by promoting a healthy skepticism about new technology. Providing educators with concrete information that separates fact from fantasy should help reduce the stress that accompanies organizational change.

Preservice and inservice programs can also address some of the broader issues involved in adopting computer technology in the early childhood setting. These issues deserve attention because the ramifications of becoming a technocentered society may have important individual, organizational, and societal consequences. Brod (1984) believes, for example, that our fascination with the computer echoes our fascination with our own power to achieve. We see the computer as an extension of the human brain, yet better, faster, and without limits. Brod goes on to say that some individuals have unfortunately developed an unhealthy dependence on the technology. They have unwittingly internalized the computer's standards as their own and have come to expect from people the perfection, accuracy, and speed to which computers have made them accustomed. They have grown impatient with human imperfection, and their style has become an extension of the machine model. In other words, they have lost the essence of what it means to be human as they "interface" with people in their daily lives. Brod may well be overstating the negative consequences of our technological future, but there still remain important issues related to the technology that warrant careful consideration.

One such issue that needs to be addressed is that of the changing perception of the educator's role and the interpersonal interaction behaviors of computer users. Most individuals enter the early childhood profession because they consider themselves "people people." As computer technology takes hold in the school office and in the classroom, it will be important to learn if the educators' traditional helping role changes and if those changes are positive ones. It will also be important to assess whether computer use facilitates or impedes the development of social interaction skills in young children in the classroom environment. These are critical issues that cut across pedagogical principles of teaching and learning and cannot be ignored.

Another issue that needs to be explored is the physical and psychological consequences of prolonged computer use. Here educators must look at some of the easily recognizable stress reactions of interacting with electronic media over an extended period of time. Symptoms such as blurry vision and eye strain, fatigue, headaches, and musculoskeletal aches and pains are serious and need to be more fully understood. In adults these symptoms may contribute to increased levels of stress and job dissatisfaction. For children whose bodies are still growing and developing, these physical reactions may well have a more permanent, detrimental effect.

The psychological consequences of prolonged computer use are more subtle and difficult to detect. One key factor that needs to be examined is the distorted sense of time that many computer users experience. Brod (1984) notes that days, hours, and minutes take on a new meaning as time is compressed and accelerated. The recognition of what is humanly possible changes. Jobs that previously took days now take hours. The result of this may be increased psychological pressure and mental overload. As individuals internalize the rapid, instant-access mode of computer operations, their inner sense of time may become distorted to accommodate the machine. For adults this kind of accelerated tempo may create increased mental pressure and stress on the job. For children this altered sense of time may also change attitudes toward traditional learning media such as books that require a slower pace and deeper reflection.

The results of this study also suggest that implementation of computer technology may result in a redefinition of time with respect to the administrator's role and responsibilities. Although time was saved by may directors on specific tasks, work as a whole tended to proliferate. New kinds of jobs were done that were not previously possible. Administrative reports that were commonly produced monthly or annually could now be done weekly. Thus the microcomputer served as both as a labor-saving device and a labor-making device. Joiner (1982) addresses this issue when he states that the introduction of the computer has spawned a new kind of problem -- information pollution — too much data with little idea of what to do with it. Moreover, in many cases the computer has also change inner standards of perfection. Since it is easier to make small deletions, changes, or insertions in working drafts of correspondence and reports, many administrators feel they have changed their inner expectations of what is acceptable.

CONCLUSION

Most educators agree that influence of computer technology on early childhood education will continue to play an important role in the years to come. The central question then for educators is how to take advantage of the opportunities presented by this new technology without disrupting organizational stability. Programs must adapt and change, but they must also not accept uncritically all change as good. Rather, administrators must evaluate, assess, and then incorporate change in the most appropriate way given the needs of the organization and the individuals involved.

This study explored some of the factors that influence early childhood administrators' willingness to adopt computer technology. It looked at patterns of acceptance and resistance in an effort to discern salient characteristics of the innovation decision process. The results of this study should prove useful in developing programs to ameliorate resistance to technological change and increase administrators' self-efficacy when implementing innovative practices.

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THE INNOVATION DECISION PROCESS

Figure 1

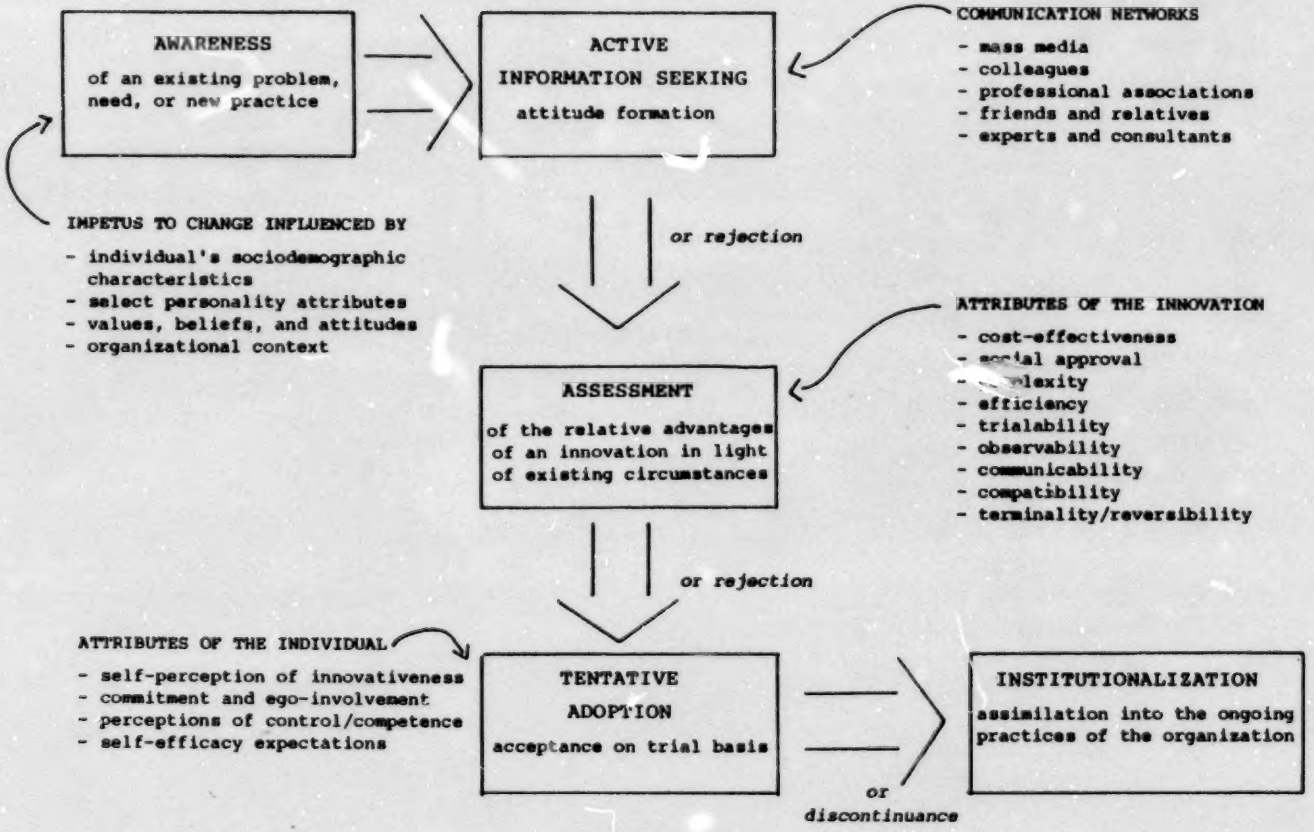

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Figure 2
Level of Computer Innovativeness

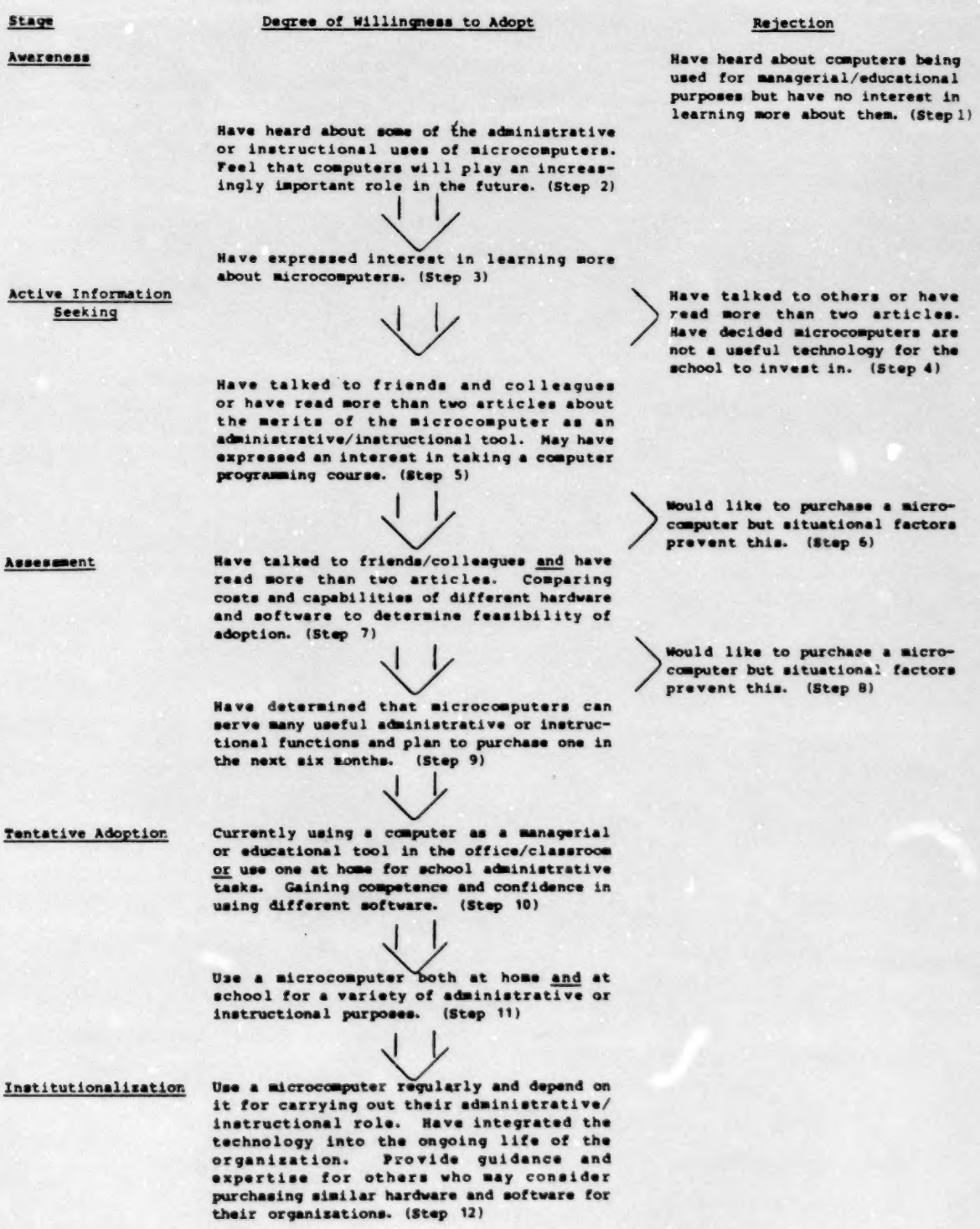
Stage
Degree of Willingness to Adopt
Rejection
Awareness
Have heard about computers being used for managerial/educational purposes but have no interest in learning more about them. (Step 1)
Have heard about some of the administrative or instructional uses of microcomputers. Feel that computers will play an increasingly important role in the future. (Step 2)
Have expressed interest in learning more about microcomputers. (Step 3)
Active Information Seeking
Have talked to others or have read more than two articles. Have decided microcomputers are not a useful technology for the school to invest in. (Step 4)
Have talked to friends and colleagues or have read more than two articles about the merits of the microcomputer as an administrative/instructional tool. May have expressed an interest in taking a computer programming course. (Step 5)
Would like to purchase a microcomputer but situational factors prevent this. (Step 6)
Assessment
Have talked to friends/colleagues and have read more than two articles. Comparing costs and capabilities of different hardware and software to determine feasibility of adoption. (Step 7)
Would like to purchase a microcomputer but situational factors prevent this. (Step 8)
Have determined that microcomputers can serve many useful administrative or instructional functions and plan to purchase one in the next six months. (Step 9)
Tentative Adoption
Currently using a computer as a managerial or educational tool in the office/classroom or use one at home for school administrative tasks. Gaining competence and confidence in using different software. (Step 10)
Use a microcomputer both at home and at school for a variety of administrative or instructional purposes. (Step 11)
Institutionalization
Use a microcomputer regularly and depend on it for carrying out their administrative/instructional role. Have integrated the technology into the ongoing life of the organization. Provide guidance and expertise for others who may consider purchasing similar hardware and software for their organizations. (Step 12)

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Table 1

Distribution of Subjects with Respect to Level of Innovativeness

Stage	Step	Administrative Uses		Instructional Uses	
		Absolute Frequency	Relative Frequency (%)	Absolute Frequency	Relative Frequency (%)
Awareness	1	2	2.5	2	2.5
	2	5	6.3	9	11.2
	3	3	3.7	3	3.7
Active Information Seeking	4	4	5.0	3	3.7
	5	13	16.2	21	26.2
	6	14	17.5	10	12.5
Assessment	7	2	2.5	7	8.8
	8	4	5.0	5	6.3
	9	8	10.0	6	7.5
Tentative Adoption	10	16	20.0	14	17.5
	11	5	6.3		
Institution-alization	12	4	5.0		
			100%		100%

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Table 2

Means, Standard Deviations, Internal Consistency and
Actual and Possible Range of Scores for all Continuous Variables*

Variable	M	SD	Internal Consistency (Alpha)	Actual Range	Possible Range
Self-Efficacy Expectations	51.91	27.27	.90	0 - 100	0 - 100
Attitudes about Computers	77.40	10.26	.86	55 - 105	21 - 115
- Appreciation of technology	27.85	3.79	.72	15 - 35	7 - 35
- Anxiety about using computers	24.13	4.52	.76	15 - 35	7 - 35
- Beliefs about negative impact	25.23	4.76	.84	12 - 35	7 - 35
Self-Perception of Innovativeness	101.43	14.35	.85	72 - 140	32 - 160
Experience and Knowledge about Computers	14.64	10.25	N/A	0 - 40	0 - 50
Experience with Educational Innovations	27.69	2.15	N/A	17 - 30	0 - 30
Outside Support and Encouragement	9.91	6.66	N/A	0 - 28	0 - 40
Professional Orientation	47.50	12.88	N/A	18 - 81	0 - 100
- Organizational characteristics	8.69	5.93	N/A	3 - 25	0 - 25
- Level of education	12.06	4.35	N/A	0 - 20	0 - 25
- Role and responsibilities	17.89	4.41	N/A	6 - 25	0 - 25
- Outside professional activities	8.86	4.17	N/A	1 - 19	0 - 25
Background in Math/Science	7.90	3.69	N/A	2 - 17	0 -

* N = 80 for all variables except Experience with Educational Innovations.
For this variable N = 73 due to incomplete questionnaire returns.

Table 3

Intercorrelations of all Variables Included in the Prediction Analyses

Variable	ADMIN USES	INSTR USES	SELF-EFFIC	ATTI-TUDES	SELF-PERCP	EXPER-IENCE	EDUC INNOV	OUTSIDE SUPPORT	PROF ORIENT	MATH/ SCIENCE	AGE	GENDER
ADMIN USES	--											
INSTR USES	.70***	--										
SELF-EFFIC	.69***	.61***	--									
ATTITUDES	.66***	.50***	.68***	--								
SELF-PERCP	.45***	.46***	.52***	.47***	--							
EXPERIENCE	.74***	.57***	.67***	.59***	.33***	--						
EDUC INNOV	.19*	.14	.23*	.01	.04	.20*	--					
SUPPORT	.40***	.31**	.41***	.34***	.20*	.29**	.03	--				
PROF ORIENT	.60***	.55***	.43***	.43***	.42***	.38***	.14	.37***	--			
MATH/SCIENCE	.34***	.19	.09	.18*	.18*	.19*	-.22*	.13	.14	--		
AGE	.02	.07	-.02	-.06	.02	-.09	.35***	-.15	.14	-.23*	--	
GENDER	.20*	.42***	.31**	.33***	.42***	.19*	.00	.15	.34***	.09	-.07	--

* significant at $p < .05$
** significant at $p < .01$
*** significant at $p < .001$

Table 4

Stepwise Multiple Regression of Independent Variables on Level of Innovativeness for Administrative Uses

Independent Variables	b	beta	standard error b	Multiple R	R Square	Adjusted R Square	t	Significance
1. Experience and Knowledge	.12	.40	.02	.74	.54	.54	4.87	.000
2. Professional Orientation	.07	.30	.02	.81	.66	.65	4.46	.000
3. Self-Efficacy	.03	.28	.01	.83	.70	.68	3.33	.001
4. Math/Science	.16	.20	.05	.86	.73	.72	3.29	.001
						Total Equation F	= 51.73*	

* significant at $p < .001$

Table 5

Stepwise Multiple Regression of Independent Variables on Level of Innovativeness for Instructional Uses

Independent Variables	b	beta	standard error b	Multiple R	R Square	Adjusted R Square	t	Significance
1. Self-efficacy	.03	.26	.01	.61	.37	.36	2.31	.024
2. Professional Orientation	.06	.28	.02	.69	.47	.46	3.08	.003
3. Gender	-1.67	-.20	.71	.71	.50	.48	-2.34	.022
4. Experience and Knowledge	.06	.25	.03	.73	.54	.51	2.31	.024

Total Equation $F = 21.57^*$

* significant at $p < .001$